# CHAPTER 150

## Vulnerability Assessment of Slums: A Case Study of Yavatmal City

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**ABSTRACT**

This paper reviews methods to determine vulnerability in urban informal settlements and then applies one such method to Yavatmal City, Maharashtra. In the context of increasing urbanization pressures and challenges faced by slum environments, the review highlights the importance of adopting integrated methods for assessment. Using the PRISMA framework, more than 600 records were screened which resulted in 35 peer-reviewed studies being selected. The review examines methods, major findings, and policy implications, with a focus on spatial approaches such as GIS mapping. Yavatmal is a case in study which mirrors the unique vulnerability backdrop of tier-2 cities rooted in the complex interplay of environmental, infrastructural, socio-economic and social vulnerabilities. Finally, the paper ends with recommendations regarding integrated frameworks, secure tenure and participatory governance and identifies research gaps that can contribute to more resilient urban development.

**Keywords:** Slum, Vulnerability; Yavatmal; GIS mapping; Socio-economic; Environmental risks; SDG11.

### 1.0 Introduction

The rapid urbanization of the world has significantly influenced the growth of slums in urban areas, with a notable concentration of slum populations in small cities and intermediate towns. As of 2020, 55% of the global population resides in urban areas, and among them, 24.2% live in slums or slum-like conditions (UNSD). The World Bank highlights that 64% of slum dwellers are in Asia, with Central and Southern Asia reporting that 31.2% of their urban population lives in slums, and Eastern and South-Eastern Asia at 27.2% (KIKUCHI, 2017). In India, as of 2020, 49% of the urban population resides in slums, despite a decrease from 55% in 2002 (Census, 2011). Slums are not confined to major cities; they are also prevalent in medium and small towns due to rapid urbanization (Kumar, 2014). Residents of slums typically face inadequate housing, limited access to safe water and sanitation, insufficient living space, and insecure tenure. This demographic represents the most deprived segment of the urban poor and is particularly vulnerable to disasters (UN-Habitat, 2004).

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The lack of proper infrastructure exacerbates environmental degradation and poses significant risks to human health, as human waste accumulates in these areas (Porio, 2011). Furthermore, slums often lack the necessary protective infrastructure to mitigate the effects of environmental degradation and climate change (Satterthwaite & Moser, 2008; Wekesa *et al.*, 2011; Alcayna-Stevens, 2015). While much research has focused on slum vulnerabilities in tier 1 cities, there exists a critical gap in studies addressing these issues in tier 2 cities. This thesis aims to assess the vulnerabilities of slums in Yavatmal City, contributing to a deeper understanding of the challenges faced by these communities in smaller urban contexts. This research will explore the socio-economic factors that exacerbate these vulnerabilities, including access to basic services, housing quality, and community resilience strategies. The aim of this research is "to gain a comprehensive understanding and to calculate the vulnerabilities faced by slum communities in urban areas, in regard to environmental, social, economic and infrastructural factors."

To achieve this aim, the study will address the following research objectives:

- To understand different vulnerabilities faced by slums in urban areas
- To identify and mark notified and unnotified slums using GIS.
- To compare vulnerability levels across different slum pockets.
- To identify National & International policies that are related to slums.
- To propose policies and interventions for vulnerable slums.

Considering the academic and practical importance of studying urban vulnerability, this review hopes to give urban planners, policymakers, and scholars a comprehensive and systematic summary of state-of-the-art practice and emerging gaps in the literature.

## 2.0 Literature Review

### 2.1 Literature search and selection

Literature follows the PRISMA method to gather various papers throughout Scopus. The process starts with searching keywords like "vulnerability, slum, redevelopment" on Scopus, and collected about 624 records found after this search, then after downloading all the documents the records are screened for duplicate documents and removed from the database, after removing all the duplicate documents. Records are screened based on their titles, and we remained with 63 papers to review. And for 2$^{nd}$ screening read all the abstracts of all 63 papers and excluded 11 papers that were irrelevant to the study for the final study read and included 27 papers. This systematic approach allowed the selection of relevant information that is not biased and ensured the analysis was holistic enough to ensure that all the available current information was understood thoroughly. Throughout the literature review 4 major areas of urban poor vulnerability have emerged which are Environmental risks, social, economic, and infrastructural vulnerability. The papers are divided into these themes accordingly for study. These major themes contain sub themes under them for developing questioners.

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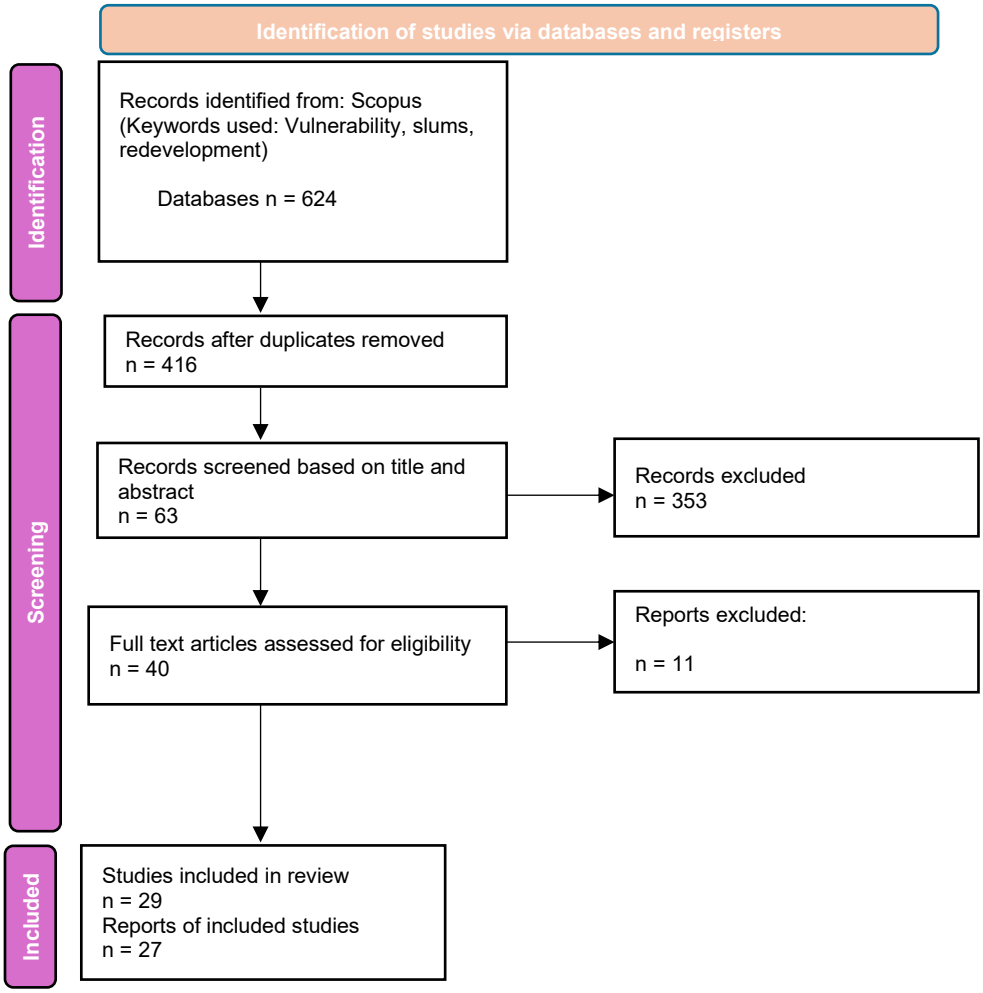
**Figure 1: PRISMA Diagram for Literature Review**




| Theme | No. of papers |
|---|---|
| Environmental Vulnerability | 8 |
| Social Vulnerability | 11 |
| Economic Vulnerability | 9 |
| Infrastructural Vulnerability | 7 |

### 2.2 Economic vulnerability

Economic vulnerability is a significant concern because slum dwellers often face job insecurity, unstable incomes, and limited savings to cope with crises or increased living costs (Khan *et al.*, n.d.). This economic instability contributes to overall vulnerability and can lead to

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increased poverty and unemployment, if not addressed promptly. The lack of financial resources often results in a cycle of poverty, where residents struggle to invest in education, healthcare, or better housing, further perpetuating their vulnerability(Khan *et al.*, 2024; Pitoyo *et al.*, n.d.). Additionally, many slum dwellers work in the informal sector, which lacks job security and social protection, making it particularly susceptible to economic shocks and downturns(Owusu & Nursey-Bray, 2019).

**2.3 Environmental vulnerability**

Environmental risk plays a crucial role in slum vulnerability. Studies have shown that slum areas are often exposed to industrial waste, proximity to hazardous sites, and poor environmental conditions, which increases health risks for residents (Effat *et al.*, 2022). Environmental hazards can lead to various health issues, including respiratory problems, waterborne diseases, and chronic illnesses. Limited access to basic services such as clean water, sanitation, and healthcare further exacerbates these vulnerabilities (Corburn & Sverdlik, 2017; Thakore *et al.*, 2024). The lack of proper waste management systems and inadequate drainage often result in the accumulation of waste and stagnant water, creating breeding grounds for disease vectors and increasing the risk of epidemics.

**2.4 Social vulnerability**

Social factors also significantly contribute to vulnerability in slum areas. Factors such as social marginalization, lack of awareness of health and hygiene practices, and limited participation in decision-making processes increase the vulnerability of slum dwellers (Mukherjee *et al.*, 2020). The social stigma associated with living in slums can lead to discrimination in employment, education, and access to public services, further marginalizing these communities. Gender-based vulnerabilities are particularly noteworthy, as women often face additional challenges due to unequal access to resources and limited participation in community decision making (Owusu *et al.*, 2018). Women in slums may experience higher rates of domestic violence, limited access to education and healthcare, and a greater burden of unpaid care, all of which contribute to their increased vulnerability(Kher *et al.*, 2015).

**2.5 Infrastructural vulnerability**

Housing conditions in slums are critical aspects of vulnerability assessment. Studies have highlighted that a significant percentage of houses in slum areas are often kutcha structures prone to collapse, indicating the risks associated with natural calamities(Khan & Kraemer, 2014). These substandard housing structures provide inadequate protection against extreme weather events, such as heavy rains, floods, or heatwaves, putting residents at risk of displacement and property loss. Overcrowding and inadequate sanitation facilities further compounded these vulnerabilities and hindered the adoption of disease-prevention measures(Brown-Luthango *et al.*, 2016). The high population density in slums makes it

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challenging to implement social distancing measures during disease outbreaks, thereby increasing the risk of rapid transmission of infectious diseases(Nguyen *et al.*, n.d.).

Geospatial techniques have emerged as valuable tools for assessing and mapping slum vulnerabilities. High-resolution satellite images and GIS techniques have been used to identify and map slum areas based on factors such as population density, tenement density, and location (Mundhe, 2019). This approach aids in sustainable urban planning and identification of vulnerable slums near environmentally sensitive areas. Geospatial analysis can help policymakers and urban planners prioritize interventions, allocate resources more effectively, and monitor changes in slum conditions over time. By integrating various data sources, including socioeconomic indicators, environmental factors, and infrastructure information, geospatial techniques provide a comprehensive understanding of slum vulnerabilities and their spatial distribution(Awasthi *et al.*, 2024). Furthermore, the interconnectedness of various vulnerability factors underscores the need for integrated and holistic approaches to slum improvement. Addressing economic vulnerabilities through livelihood support programs, for instance, can have positive spillover effects on health and educational outcomes. Similarly, improving environmental conditions through improved waste management and sanitation infrastructure can lead to improved health outcomes and increased economic productivity.

In conclusion, the vulnerability assessment of slums requires a comprehensive approach that considers the economic, environmental, social, and infrastructural factors. The case study of Yavatmal can benefit from these insights to develop targeted interventions and policies aimed at reducing vulnerability and improving the overall quality of life for slum residents. By addressing the root causes of vulnerability and leveraging community strength, it is possible to create more resilient and sustainable urban environments that promote the well-being of all residents, including those in slum areas.

## 3.0 Methodology: Review Approach

This study utilizes a systematic review approach that emphasizes the collection, evaluation, and synthesis of previous studies on urban slum vulnerability. As opposed to collecting original data, the emphasis is on a systematic reviewing procedure that synthesizes evidence across various types of research methods.

### 3.1 Search strategy and inclusion measures

The search was carried out by looking for appropriate studies in several trustworthy databases using a mixture of key words. Inclusion criteria were:

- Peer-reviewed articles published in reputable conference proceedings or in peer-reviewed journals.
- Research that targets one or more aspects of the vulnerability of the slum, particularly studies using GIS mapping and MCDM methods.
- Research in various geographic settings using concrete data on population trends in urban slums.

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### 3.2 Quality evaluation and data extraction

The selected studies were screened for methodological quality and relevance to the urban slum environment. Data were extracted to note the indicators of vulnerability used, the methods applied, and the implications for policies that were considered. Narrative synthesis and quantitative aggregations were used where feasible in order to synthesize results across the included studies.

### 3.3 Contextual link with Yavatmal city

The distinctive Yavatmal City setting is integrated by aligning the international literature using specific prior field experience findings. The discussion considers how methods like the use of GIS and the Multi-Criteria Decision Making (MCDM) method applied in Yavatmal previously can be integrated with larger conclusions to provide actionable solutions for city planners in other similar tier-2 cities.

## 4.0 Results and Discussion

### 4.1 Synthesis of findings of the literature

The analysis yielded strong differences between studies in how vulnerability is defined and assessed. In spite of these differences, there is a clear agreement that vulnerability in urban slums is multidimensional and intertwined. For instance, studies conducted using spatial analysis uniformly indicate that environmental hazards are heightened by infrastructural conditions. Equally, social and economic vulnerabilities are revealed to reinforce one another, where low literacy levels and casual labor further constrain community resilience and adaptation capacity.

### 4.2 A comparison across studies shows that

- Research that utilizes GIS mapping offers a scientific basis for determining environmental risk assessment yet might lack socio-economic sophistication.
- MCDM methods provide a strong system to synthesize various vulnerability indicators, but their efficacy is reliant upon the quality of the input data.
- Qualitative studies give in-depth contextual information on social and economic issues, though rarely quantify the degree of vulnerabilities.

### 4.3 Contextual analysis: Yavatmal city insights

The analysis also gives a comprehensive overview of the Yavatmal City case, citing important vulnerabilities that reflect global trends as well as unique local issues. Field studies and prior analyses in Yavatmal have pointed towards critical issues like:

- The heavy concentration of slum settlements in environmentally risky or flood-prone areas, primarily a result of fast and unplanned urban expansion.

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- Characterized by a socio-economic profile of high informal employment and financial insecurity that results in a persistent cycle of poverty.
- Infrastructural shortcomings, such as insufficient water supply, sanitation, and uncertain road networks, that directly raise the level of susceptibility of residents during emergencies

The precise GIS mapping in earlier studies in Yavatmal offers unambiguous spatial trends corresponding to the conclusions in the larger literature, and hence offers support to the usefulness of integrated assessment frameworks in various city contexts.

## 5.0 Policy Implications and Recommendations

Based on the synthesis of the literature and the contextual observations in Yavatmal, the following policy recommendations arise:

- *Integrated assessment tools:* Policymakers and urban planners ought to use integrated vulnerability assessment tools that integrate GIS mapping and MCDM methods. Integrating GIS mapping and MCDM methods would enable them to get a better understanding of how various vulnerabilities interact.
- *Infrastructure strengthening:* Investment in the upgrading of core infrastructure—water supply, sanitation facilities, roads, etc.—is the key to vulnerability reduction in the slum environment. Moreover, policies which support enhancing secure tenure can also build lasting resilience.
- *Economic empowerment and social inclusion:* Economic and social inclusion initiatives in the form of microfinance schemes and vocational skill development schemes are the key to eradicating the cycle of poverty. Additionally, improving social engagement and ensuring that marginalized communities, women in particular and minority groups, benefit by having a voice in urban planning can result in better and inclusive policies.
- *Regular monitoring and evaluation:* Having a system of regular monitoring of vulnerability indicators through the application of improved spatial and decision-support tools will allow for timely adjustments of policies and resource allocations.

## 6.0 Limitations and Areas for Future Research

While the literature contains many studies of slum vulnerability, in the review the authors find multiple gaps in the research:

- The majority of studies focus largely on environmental and infrastructural vulnerabilities but give less consideration to long-term socio-economic concerns.
- Much of the assessment is cross-sectional, and there is a need for longitudinal studies that track how vulnerabilities change over time.
- The diversity of methodologies reduces the comparability of findings across contexts. This may provide a basis for the development of standardized indicators and assessment procedures that would allow comparative analysis with implications for public policy.

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These reflect promising avenues for future work, which could include more integrative, longitudinal studies that involve local stakeholders directly in the research process.

## 7.0 Conclusion

In this paper, we have conducted a systematic review of the existing literature on vulnerability assessment as understood in urban slums, synthesising a diverse body of work to draw attention to the multidimensionality of vulnerability. The synthesis demonstrates that integrated approaches with a specific focus on those incorporating GIS and MCDM tools can provide a promising platform for assessing and addressing risks in slum contexts. Yavatmal City, as a case study, highlights how tier-2 cities in India are plagued with these pressing challenges – Infrastructure deficits, socio-economic instability, and environmental hazards combine to make vulnerability worse.

*The review ends with a number of key recommendations:*

- Multidisciplinary assessment frameworks should be employed, embracing the environmental, infrastructural, social and economic dimensions of urban policies.
- Improvement in living conditions of slum dwellers depends crucially on investment in basic services and secure tenure, and economic empowerment and inclusive governance.
- Regular, standardised monitoring will enable the adjustment of policies over time to the changing nature of the threats posed, making sure that interventions remain responsive and effective.

In conclusion, the existing methods can provide insight into vulnerabilities present in urban slums, however there are considerable opportunities to improve and standardize these methods. Mitigating those gaps via integrative research and policy actions may lead to resilient urban settings, contributing to sustainable development for everyone.

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